UNIVERSITI TEKNOLOGI MARA

STRENGTH AND SHRINKAGE OF INCINERATED WASTE PAPER SLUDGE ASH BASED GEOPOLYMER CONCRETE INCORPORATING RECYCLE CONCRETE AGGREGATE

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of the requirement for the degree of
Master of Science

Faculty of Civil Engineering

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CONFIRMATION BY PANEL OF EXAMINERS

I certify that a Panel of Examiners has met on 21th April 2015 to conduct the final examination of Khairulniza Binti Ahmad Anuar on her Master of Science thesis entitled "Strength And Shrinkage Of Incinerated Waste Paper Sludge Ash Based Geopolymer Concrete Incorporating Recycle Concrete Aggregate" in accordance with Universiti Teknologi MARA Act 1976 (Akta 173). The Panel of Examiners recommends that the student be awarded the relevant degree. The panel of Examiners was as follows:

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AUTHOR'S DECLARATION

I declare that the work in this thesis/dissertation was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the result of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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ABSTRACT

Concrete is widely used as construction material. However, the production material of concrete which is cement (OPC) and natural aggregate (NA) become are major concern. Waste paper sludge ash (WPSA) is a by-product and problematic waste of paper industries in Malaysia. WPSA is found having a potential to replace OPC as a concrete binder. Geopolymer concrete technology is seen as one of the best option to reduce the amount of CO^2 emitted in OPC production in order to satisfy construction material needs. The use of Recycle Concrete Aggregate (RCA) may help to reduce the effects of the construction and demolition (C&D) activities by reusing waste materials and preventing NA from being harvested. Somehow the utilization of by-product material such as WPSA with RCA in geopolymer concrete was very limited. The main reasons to use RCA in this geopolymer concrete is to make construction more ''green'' and environmental friendly. Therefore, the WPSA based geopolymer concrete incorporating RCA are been conducted. The main objective of this present study is to determine the compressive strength and shrinkage performance of WPSA based geopolymer concrete incorporating RCA. In the present study, WPSA and the combination of sodium hydroxide (NaOH) and sodium silicate (Na_2SiO_3) were used as a binder. Fifteen (15) series of specimens comprising three (3) different molarities of NaOH which are 8M, 12M and 14M and different percentages of RCA which are 0%, 25%, 50%, 75% and 100% were adopted. There are 270 cube specimens size 100mm x 100mm x100mm and 45 prism specimens size 300mm x 75mm x 75mm were prepared. The tests were conducted after aging the specimen at 1, 3, 7, 14, 28, 56 and 90 days cured in ambient temperature. The mineralogical composition and microstructural of the geopolymer were also determined by using X-ray Florescence (XRF), Scanning electron microscopy (SEM) and elemental analysis using Energy Dispersive X-Ray Spectroscopy (EDX). Experimental results show the highest compressive strength was obtained with the use of 12M NaOH which is 6.788 N/mm^2. However the shrinkage level of the geopolymer is low with range 3.5×10^{-5} to 7.0×10^{-5} for all series. SEM of the WPSA based geopolymer concrete indicated that the presence of NaOH and Na_2SiO_3 produced low porosity of geopolymer due to low geopolymerization rate and heterogeneous matrix with a high content of unreacted element.

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